CERTIFICATION

I, Yoshiko Kato, of c/o Toyota Techno Service Corp., 2-88, Hoei-cho, Toyota, Aichi, 470-1201 Japan, solemnly and sincerely declare:

That I have thorough knowledge of Japanese and English languages; and

That the attached pages contain a correct translation into English of the following Japanese patent application:

APPLICATION NUMBER	DATE OF APPLICATION
2002-364414	December 16, 2002

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 17th day of July, 2005.

Yoshiko Kato

[NAME OF THE DOCUMENT] APPLICATION FOR PATENT

[SERIAL NUMBER] PN0446

[ADDRESSEE] Commissioner of Patent Office

[INT. CL.] H01L 29/84

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[APPLICATION FEE]

[PAYMENT NUMBER] 053729

[AMOUNT OF PAYMENT] 21,000 yen

[LIST OF ATTACHED DOCUMENTS]

[NAME OF THE DOCUMENT] Specification 1

[NAME OF THE DOCUMENT] Drawings 1

[NAME OF THE DOCUMENT] Abstract 1

[REQUIREMENT OF PROOF] Required

[NAME OF THE DOCUMENT] Specification

[TITLE OF THE INVENTION] PRESSURE SENSOR

[CLAIMS]

[Claim 1]

A pressure sensor including a semiconductor device capable of detecting a pressure, a terminal that is connected to the semiconductor device by a bonding wire, a housing having an accommodation space for accommodating the semiconductor device, the bonding wire and the terminal, a diaphragm for sealing the accommodation space, and working fluid which is sealed in the accommodation space and which transmits the pressure applied to the diaphragm to the semiconductor device, characterized in that the working fluid is a silicone-based oil, and the terminal and the housing are sealed by a fluorine-based adhesive.

[Claim 2]

A pressure sensor including a semiconductor device that is capable of directly detecting a pressure, a terminal that is connected to the semiconductor device by a bonding wire, and a housing having an accommodation space for accommodating the semiconductor device, the bonding wire and the terminal, characterized in that the terminal and the housing are sealed by a fluorine-based adhesive.

[Claim 3]

The pressure sensor according to claim 1 or 2, characterized in that the fluorine-based adhesive is a perfluoro polyether resin composition.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field]

The invention relates to a pressure sensor.

[0002]

[Related Art]

A pressure sensor described in Patent Literature 1 is known. This pressure sensor is provided with a semiconductor device that is capable of detecting a pressure, a terminal that is connected to the semiconductor device by a bonding wire, a housing having an accommodation space for accommodating the semiconductor device, the bonding wire and the terminal, a diaphragm for sealing the accommodation space, and working fluid which

is sealed in the accommodation space and which transmits a pressure applied to the diaphragm to the semiconductor device. Fluorine-based oil that is composed of perfluoro polyether is used as the working fluid. In general, silicone-based adhesive is used in this type of the pressure sensor for sealing between the terminal and the housing.

[0003]

In a pressure sensor like this, the diaphragm deforms when a pressure to be detected acts on the diaphragm, and the pressure is transmitted to the semiconductor device by the working fluid. The semiconductor device detects the pressure, a signal thereof is sent to the terminal via the bonding wire, and is then sent to other devices by the terminal. In this case, in this pressure sensor, while the fluorine-based oil as the working fluid maintains favorable pressure transmissibility, swelling of the silicone-based adhesive is prevented due to characteristics of fluorine compound and silicone compound. Accordingly, in this pressure sensor, reduction in adhesivity of the silicone-based adhesive is prevented, whereby sealability between the terminal and the housing is maintained and durability is also demonstrated.

[0004]

Furthermore, a pressure sensor as described in Patent Literature 2 is also known. This pressure sensor is provided with a semiconductor device that is capable of directly detecting a pressure, a terminal that is connected to the semiconductor device by a bonding wire, and a housing having an accommodation space for accommodating the semiconductor device, the bonding wire, and the terminal, but it is not provided with the aforementioned diaphragm. Moreover, the semiconductor device, the bonding wire, and the terminal are buried in fluorine-based gel that is filled in the accommodation space as the working fluid, and further, an upper portion of the terminal and the housing are coated with fluorine-based adhesive.

[0005]

In this pressure sensor, when a pressure to be detected acts on the surface of the fluorine-based gel, the pressure is transmitted to the semiconductor device by the fluorine-based gel. The semiconductor device detects the pressure, a signal thereof is sent to the terminal via the bonding wire, and is then sent to other devices by the terminal. In this case, in this pressure sensor, the fluorine-based gel and the fluorine-based adhesive demonstrate durability by being exposed to gasoline vapor, water vapor, or the like.

[0006]

[Patent Literature 1]

Japanese Patent Publication No. 2819783

[0007]

[Patent Literature 2]

Japanese Patent Laid-Open Publication No. 2001-99737

[0008]

[Problem to be Solved by the Invention]

However, since the pressure sensor described in Patent Literature 1 uses expensive fluorine-based oil as the working fluid, a large amount of the fluorine-based oil is used, thus causing a sharp increase in the manufacturing cost. With regard to this respect, if low-cost silicone-based oil is used as the working fluid instead of the fluorine-based oil, since the terminal and the housing are sealed by the silicone-based adhesive, the silicone-based adhesive swells due to characteristics of both silicone resins, thus reducing adhesivity. As a result, sealing between the terminal and the housing becomes insufficient, thereby causing a concern about durability.

[0009]

Furthermore, in the pressure sensor described in Patent Literature 2 uses both fluorine-based gel and fluorine-based adhesive for protection from the outside. Therefore, the manufacturing cost increases sharply.

[0010]

The invention has been devised in consideration of the above conventional problems, and it is an object thereof to provide a solution by providing a pressure sensor with which a pressure can be detected with high sensitivity, and a low manufacturing cost can be achieved.

[0011]

[Means for Solving the Problem]

A pressure sensor of a first invention is a pressure sensor which includes a semiconductor device that is capable of detecting a pressure, a terminal that is connected to the semiconductor device by a bonding wire, a housing having an accommodation space for accommodating the semiconductor device, the bonding wire and the terminal, a diaphragm for sealing the accommodation space, and working fluid sealed in the accommodation space for transmitting a pressure that is applied to the diaphragm to the semiconductor device.

[0012]

A characterizing feature thereof is that the working fluid is silicone-based oil, and the terminal and the housing are sealed by a fluorine-based adhesive.

[0013]

In the pressure sensor according to the first invention, the diaphragm deforms when a pressure to be detected acts on the diaphragm, and the pressure is transmitted to the semiconductor device by the working fluid. The semiconductor device detects the pressure, and a signal thereof is sent to the terminal via the bonding wire, and is then sent to other devices by the terminal. In this case, in this pressure sensor, the silicone-based oil as the working fluid maintains favorable pressure transmissibility. In addition, adhesive performance of the recent fluorine-based adhesive has been significantly improved. Furthermore, swelling of the silicone-based adhesive is prevented due to characteristics of a fluorine compound and a silicone compound. Therefore, in this pressure sensor, sealability between the terminal and the housing is maintained by preventing reduction in adhesivity of the fluorine-based adhesive, thus durability is demonstrated. Moreover, since the silicone-based oil is less expensive than the fluorine-based oil, a manufacturing cost does not increase sharply even when a large amount of the silicone-based oil is used as the working fluid.

[0014]

A pressure sensor of a second invention is a pressure sensor which includes a semiconductor device that is capable of directly detecting a pressure, a terminal that is connected to the semiconductor device by a bonding wire, and a housing having an accommodation space for accommodating the semiconductor device, the bonding wire and the terminal.

[0015]

A characterizing feature thereof is that the terminal and the housing are sealed by the fluorine-based adhesive.

[0016]

In the pressure sensor according to the second invention, a pressure to be detected is directly detected by the semiconductor device, and a signal thereof is sent to the terminal via the bonding wire, and is then sent to other devices by the terminal. In this case, in this pressure sensor, the terminal and the housing are sealed only by the fluorine-based adhesive with significantly improved adhesive performance, and no working fluid is provided. As a result, the low manufacturing cost can be achieved.

[0017]

Therefore, a pressure can be detected with high sensitivity, and the low manufacturing cost can be achieved according to the pressure sensor of the first invention and the second invention.

[0018]

According to the results of tests conducted by the inventors, it is preferable for the pressure sensor of the first invention and the second invention that the fluorine-based adhesive is perfluoro polyether resin composition. It is also preferable that the perfluoro polyether resin composition is a curable resin composition that is composed of (A) a straight-chain fluoropolyether compound containing an alkenyl group in a molecule and having a perfluoro polyether structure in the back bone, (B) a fluoride organic silicone compound having hydrogen atom bonded to a silicone atom in a molecule, and (C) a platinum group compound. This type of the fluorine-based adhesive is, for example, disclosed in Japanese Patent Laid-Open Publication No. HEI 9-95615.

[0019]

[Embodiments of the Invention]

Hereinafter, first and second embodiments of the invention will be explained with reference to the accompanying drawings.

[0020]

(First embodiment)

A pressure sensor according to a first embodiment is provided with a housing 3, a diaphragm 8 and working fluid 9 as shown in FIG. 1. The housing 3 is composed of a first housing 1 made from, for example, PPS (polyphenylene sulfide) and a second housing 2 that is made from steel and provided on the periphery of one end of the first housing 1. The one end of the first housing 1 and the second housing 2 form an accommodation space 4. The accommodation space 4 is sealed by the diaphragm 8 that is sandwiched between the first housing 1 and the second housing 2. In addition, a connector 1a for electrical connection to the outside is formed on the other end of the first housing 1. One end of the second housing 2 is provided with an introducing hole 2a that penetrates therethrough for introducing a detected substance 11 to the side of the diaphragm 8. The other end is crimped to the first housing 1. In addition, the working fluid 9 of the silicone-based oil is sealed in the accommodation space 4.

[0021]

As shown in FIG. 2, a semiconductor device 5 that is capable of detecting a pressure and a terminal 6 that is connected to the semiconductor device 5 by a bonding

wire 7 are accommodated in the accommodation space 4. The semiconductor device 5 is adhered to the first housing 1. In addition, as shown in FIG. 1, the terminal 6 is provided to penetrate through the first housing 1 such that one end is protruded to the accommodation space 4 and the other end is protruded to the inside of the connector 1a. An end of the terminal 6 is, as shown in FIG. 2, integrally adhered to the first housing 1 by a fluorine-based adhesive 10 in a sealed state, thus preventing working fluid from leaking from a minute gap between the terminal 6 and the first housing 1. In the present embodiment, a perfluoro polyether resin composition (SIFEL614 made by Shin-Etsu Chemical Co., Ltd.) is adopted as the fluorine-based adhesive 10.

[0022]

In the pressure sensor configured as above, the diaphragm 8 receives a pressure of a detected substance 11 that is introduced from the introducing hole 2a of the second housing 2, and the working fluid 9 transmits the pressure to the semiconductor device 5. Then, the pressure is converted to an electric signal by the semiconductor device 5. This electric signal is taken outside via the bonding wire 7 and the terminal 6 of the connector 1a.

[0023]

In this case, in the pressure sensor, the silicone-based oil which is the working fluid 9 maintains favorable pressure transmissibility. In addition, the fluorine-based adhesive 10 demonstrates favorable adhesive performance. Furthermore, swelling of the fluorine-based adhesive 10 is prevented due to characteristics of a silicone compound and a fluorine compound. As a result, in the pressure sensor, sealability between the terminal 6 and the first housing 1 is maintained by preventing reduction in adhesivity of the fluorine-based adhesive 10, thus durability is demonstrated. Moreover, since the silicone-based oil is less expensive than the fluorine-based adhesive 10, a sharp increase in a manufacturing cost is not caused even when a large amount of the silicone-based oil is used as the working fluid 9.

[0024]

Therefore, a pressure can be detected with high sensitivity, and the low manufacturing cost can be achieved according to the pressure sensor of the first embodiment.

[0025]

(Second embodiment)

As shown in FIG. 3 and FIG. 4, a pressure sensor according to a second embodiment is provided with a semiconductor device 5 that is capable of directly detecting a pressure, and a housing 23 having an accommodation space 24. The semiconductor device 5, a bonding wire 7, and a terminal 6 are accommodated in the accommodation space 24. The housing 23 is composed of a first housing 21 made from, for example, PPS (polyphenylene sulfide) and a second housing 22 that is made from steel and provided on the periphery of one end of the first housing 21. The one end of the first housing 21 forms the accommodation space 24 with the second housing 22. In addition, a connector 21a for electrical connection to the outside is formed on the other end of the first housing 21. One end of the second housing 22 is provided with an introducing hole 22a that penetrates therethrough for introducing a detected substance 11. The other end is crimped to the first housing 21. The accommodation space 24 and the introducing hole 22a are communicated with each other.

[0026]

The semiconductor device 5 is adhered to the first housing 21. In addition, the terminal 6 is provided to penetrate through the first housing 21 such that one end is protruded to the accommodation space 24 and the other end is protruded to the inside of the connector 21a. The terminal 6 is adhered to the first housing 21 by the fluorine-based adhesive 10. In the present embodiment, a perfluoro polyether resin composition (SIFEL614 made by Shin-Etsu Chemical Co., Ltd.) is also adopted as the fluorine-based adhesive 10.

[0027]

In the pressure sensor configured as above, a pressure of the detected substance 11 that is introduced from the introducing hole 22a of the second housing 22 is directly transmitted to the semiconductor device 5. Then, the pressure is converted to an electric signal by the semiconductor device 5. This electric signal is taken outside via the bonding wire 7 and the terminal 6 of the connector 21a.

[0028]

In this case, in the pressure sensor, the terminal 6 and the first housing 21 are sealed only by the fluorine-based adhesive 10 whose adhesive performance has been significantly improved. A sealing function of the fluorine-based adhesive 10 reliably prevents the detected fluid from leaking from a minute gap between the terminal 6 and the first housing 21. In addition, the working fluid is not provided, therefore, the low manufacturing cost can be achieved.

[0029]

Therefore, a pressure can be detected with high sensitivity, and the low manufacturing cost can be also achieved according to the pressure sensor of the second embodiment. In addition, since the pressure sensor is not provided with a diaphragm, the low manufacturing cost can be further reduced.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[FIG. 1]

FIG. 1 is a cross sectional view of a pressure sensor according to a first embodiment.

[FIG. 2]

FIG. 2 is an enlarged cross sectional view of a pressure sensor according to the first embodiment.

[FIG. 3]

FIG. 3 is a cross sectional view of a pressure sensor according to a second embodiment.

[FIG. 4]

FIG. 4 is an enlarged cross sectional view of a pressure sensor according to the second embodiment.

[Description of the Reference Numerals]

3, 23 ... HOUSING

5 ... SEMICONDUCTOR DEVICE

6 ... TERMINAL

7 ... BONDING WIRE

4, 24 ... ACCOMMODATION SPACE

8 ... DIAPHRAGM

9 ... WORKING FLUID

10 ...FLUORINE-BASED ADHESIVE

[NAME OF THE DOCUMENT] Abstract of the disclosure

[ABSTRACT]

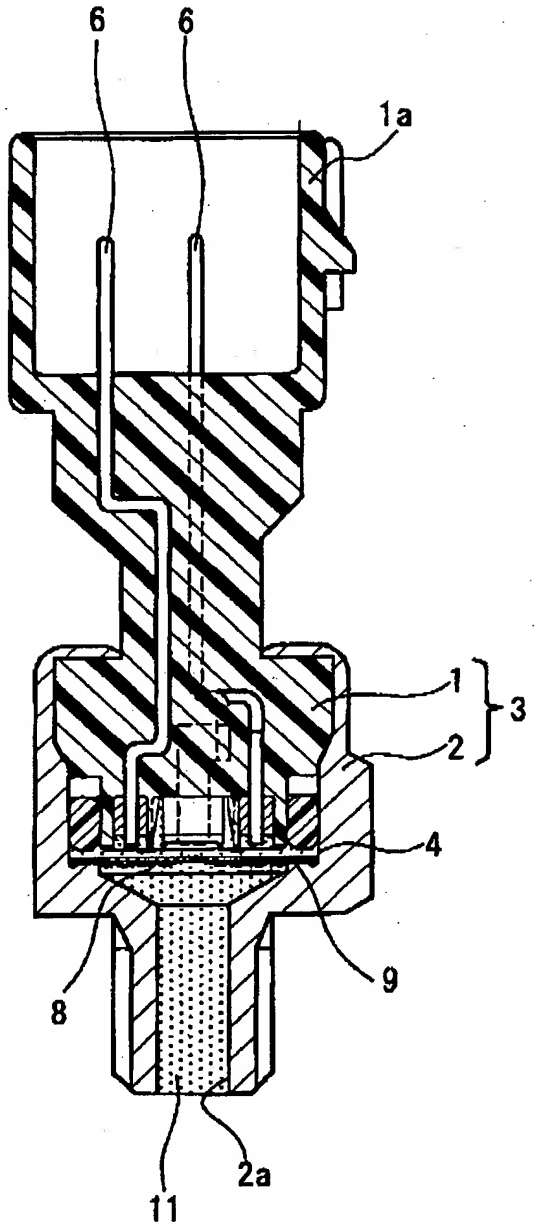
[TASK] To provide a pressure sensor which is capable of detecting pressure with high sensitivity, and capable of realizing low manufacturing cost.

[MEANS OF SOLVING THE PROBLEM] This is provided with a semiconductor device 5 that is capable of detecting a pressure, a terminal 6 that is connected to the semiconductor device 5 by a bonding wire 7, a housing 3 having an accommodation space 4 for the semiconductor device 5, the bonding wire 7, and the terminal 6, a diaphragm 8 for sealing the accommodation space 4, and working fluid 9 that is sealed in the accommodation space 4 and transmits a pressure applied to the diaphragm 8 to the semiconductor device 5. The working fluid 9 is silicone-based oil, and the terminal 6 and the housing 3 are sealed by fluorine-based adhesive 10.

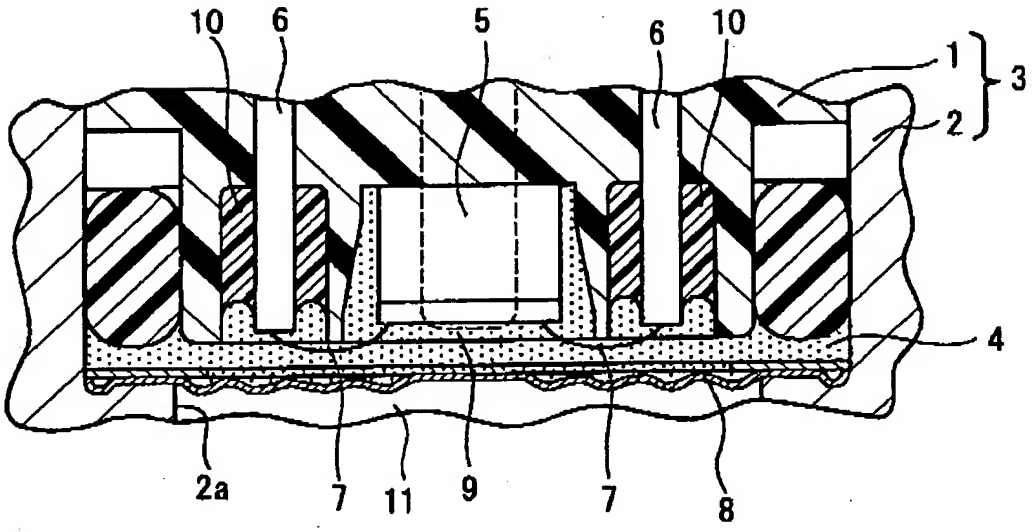
[SELECTED DRAWING] FIG. 1

[NAME OF THE DOCUMENT] DRAWINGS

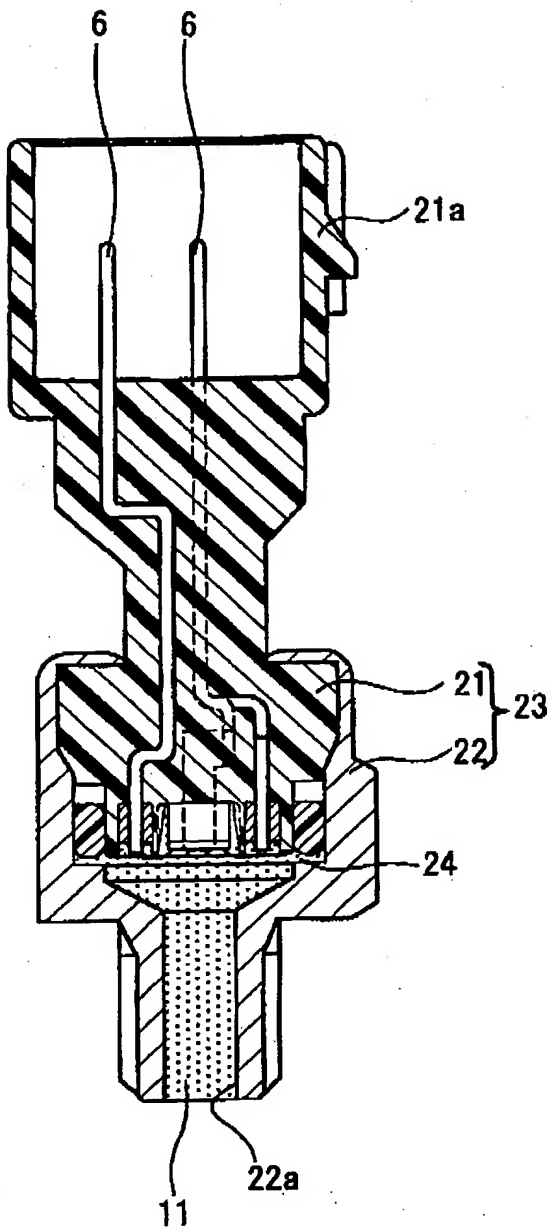
[Fig. 1]



[Fig. 2]



[Fig. 3]



[Fig. 4]